

Application Note – Monitoring Platform Performance Ratio Calculation and Activation

Version History

- Version 2.1 (Apr. 2018) – Typo correction in formulas
- Version 2 (Dec. 2017) – Addition of satellite-based service for PR calculations
- Version 1 (Jan. 2016) – Initial release; Performance Ratio (PR) calculation using sensors

Introduction

The performance ratio (PR) of a PV installation is defined by the difference between the actual energy yield of a site (production energy), and the expected energy of the site, based on the module type and environmental sensor measurements. The PR value ranges between 0 and 1 and is used to evaluate the PV system performance: A high PR indicates a properly operating site. You can use the PR to compare the performance of several systems in different locations, monitor a site's performance over time and check if a site is meeting its energy production targets.

To allow displaying the PR in the dashboard of the site, the following is required:

- One of the following data sources:
 - A direct irradiance sensor installed at the site and connected to the monitoring platform¹. The sensor orientation and tilt have to be the same as that of the PV modules so that the sensor is exposed to the same solar irradiation. Use a Control and Communication Gateway (CCG) to connect the sensor to the SolarEdge monitoring platform. To use sensors, the CCG firmware version must be 2.07XX and later (refer to *Appendix B: Software Compatibility Check and Upgrade* on page 6).
Optionally, installing a module temperature sensor in addition to the irradiance sensor increases the accuracy of the PR calculation. This is not mandatory for calculating the PR.
 - A satellite-based service, which provides PR calculations based on irradiance information from satellites. This service is available only in some regions, and can be purchased whether or not sensors are installed at the site. For more information, refer to <https://www.solaredge.com/us/products/pv-monitoring/satellite-based-pr>, or <https://www.solaredge.com/products/pv-monitoring/satellite-based-pr>. This option requires a published physical layout. If a physical layout does not exist, create one by following the instructions in <https://www.solaredge.com/sites/default/files/se-monitoring-portal-site-admin.pdf>
- Setting the PR information in the monitoring platform (refer to *Setting up the PR Display in the Monitoring Platform Dashboard* on page 1).

This application note describes how to set the monitoring platform to display the PR value. For information about connecting sensors to the CCG and configuring the system, refer to the *SolarEdge Control and Communication Installation Guide* available on the SolarEdge website at <http://www.solaredge.com/files/pdfs/solaredge-gateway-installation-guide.pdf>.

For detailed PR calculation information, refer to *Appendix A: PR Calculation* on page 6.



NOTE

In case you purchased and configured more than one PR data source (sensors or satellite), PR calculations are viewable for one source at a time.

Setting up the PR Display in the Monitoring Platform Dashboard

Sensors as data source

When the sensor(s) is installed, connected to the CCG and configured, you can edit the sensor(s) settings in the monitoring platform in order to display the PR in the site dashboard.

To use sensors, the CCG firmware version must be 2.07XX and later. For information about software compatibility and upgrade refer to *Appendix B: Software Compatibility Check and Upgrade* on page 6.

¹ Sensors are available from SolarEdge – refer to http://www.solaredge.com/files/pdfs/products/inverters/se_sensor_datasheet.pdf

1. Log in to the monitoring platform (monitoring.solaredge.com) using your user name and password.
2. Click on a site to access its dashboard.
3. Click the **Admin** icon and select the **Performance** tab. If a sensor is installed (or the satellite-based PR service was purchased), the **Performance Ratio** tab is displayed:

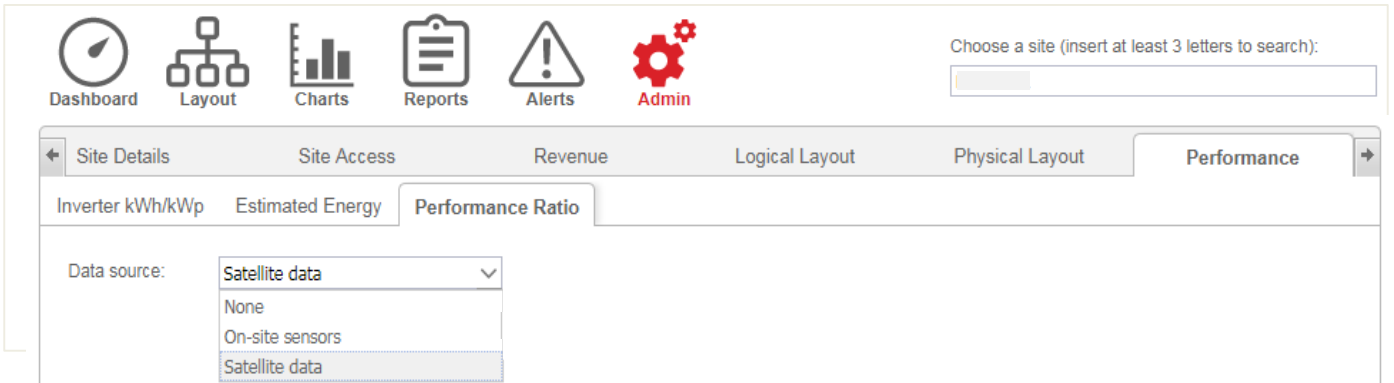


Figure 1: Performance Ratio tab

4. From the Data source drop-down list, select **On-site Sensors**. The following information is displayed (see *Figure 2*):
 - The site DC peak power
 - The associated peak power, which is the power of the array in which the sensors are installed. This number will be used to calculate the PR and is displayed after the sensor settings are edited as described below. For multi-orientation sites, the associated peak power is the sum of powers of all arrays that have a sensor installed.



NOTE

The site peak power is taken from the the site details. The sum of associated peak power values of the CCGs should equal the site peak power value.

- Gateway (CCG) name and sensors information
5. To enable PR calculation using the sensor(s) readings, select the **Gateway** check-box. The sensor settings are displayed and can be edited in this section.

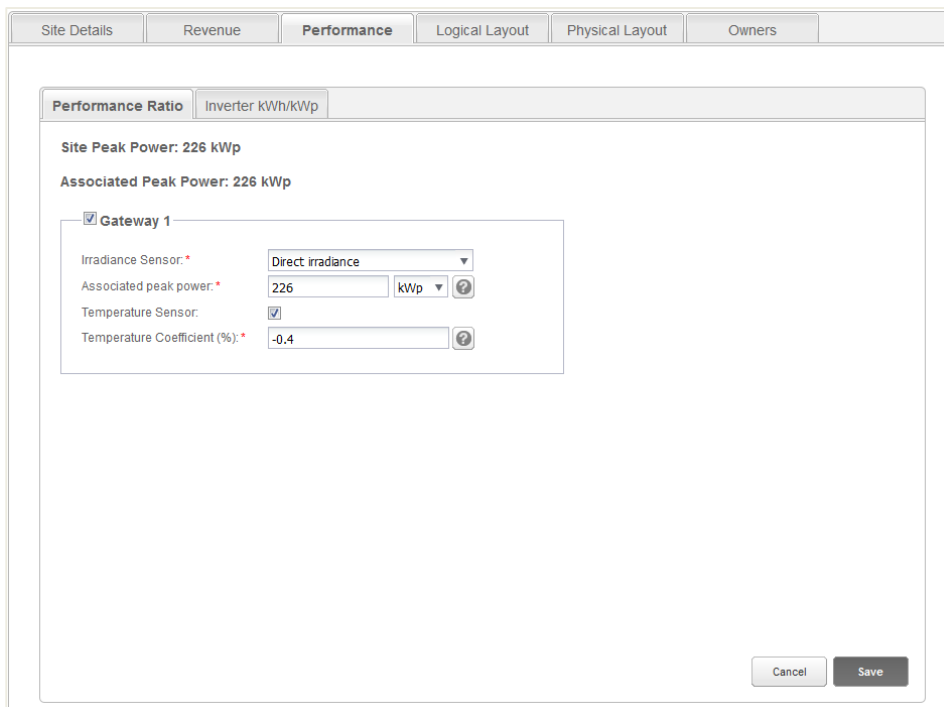


Figure 2: Performance Ratio Administration – single gateway

6. Edit the sensor(s) settings:
 - Verify that the **Irradiance Sensor** configuration is the same as appears in the CCG.
 - Enter the **Associated peak power** value and select the units (Wp, kWp or MWp). This value will be displayed in the Associated Peak Power header.
 - If a module temperature sensor is installed at the site and you want the PR calculation to use its readings, select the **Temperature Sensor** check-box. The Temperature Coefficient field is displayed.

- Enter the module's power **Temperature Coefficient** (in %P/°C). This value must be negative. In case you do not have the module datasheet you may use -0.4 as a default number.
7. In case of multiple orientations, thus more than one CCG, repeat steps 7-8 for each of the CCGs whose sensor measurements you want to include in the PR calculation.

Figure 3: Performance Ratio Administration – multiple gateways



NOTE

Gateway names may be modified in the gateway details form to have more meaningful names.

8. Click **Save**.

Satellite PR as data source

If you purchased the satellite-based PR service, you can use it as the PR calculation source.

1. Log in to the monitoring platform (monitoring.solaredge.com) using your user name and password.
2. Click on a site to access its dashboard.
3. Make sure the site has a published physical layout: Click the **Admin** icon and select the **Physical Layout** tab. If a physical layout does not exist, create one by following the instructions in: <https://www.solaredge.com/sites/default/files/se-monitoring-portal-site-admin.pdf>.
4. Click the **Admin** icon and select the **Performance** tab. If the satellite-based PR service was purchased, the **Performance Ratio** tab is displayed.

Figure 4: Performance Ratio tab

5. From the Data source drop-down list, select **Satellite data**. The following information is displayed (see *Figure 5*):
 - Site peak DC power

- Modules peak power, which is the power all installed modules. This number will be used to calculate the PR and is displayed after the modules settings are edited as described below. For multi-orientation sites, the total peak power is the sum of powers of all.



NOTE

The site peak power is taken from the the site details. The sum of modules peak power values should equal the site peak power value.

6. Select a **Start date** from which to display the performance ratio.
7. Select the Installation Type:

- Free standing – modules are installed in the field
- Building integrated – modules are part of the building walls
- Roof mounted – modules are installed on the rooftop

A table is displayed, showing a line of information for each type of modules: number of modules, number of power optimizers, tilt and azimuth of the modules, and the power produced from the group of modules.

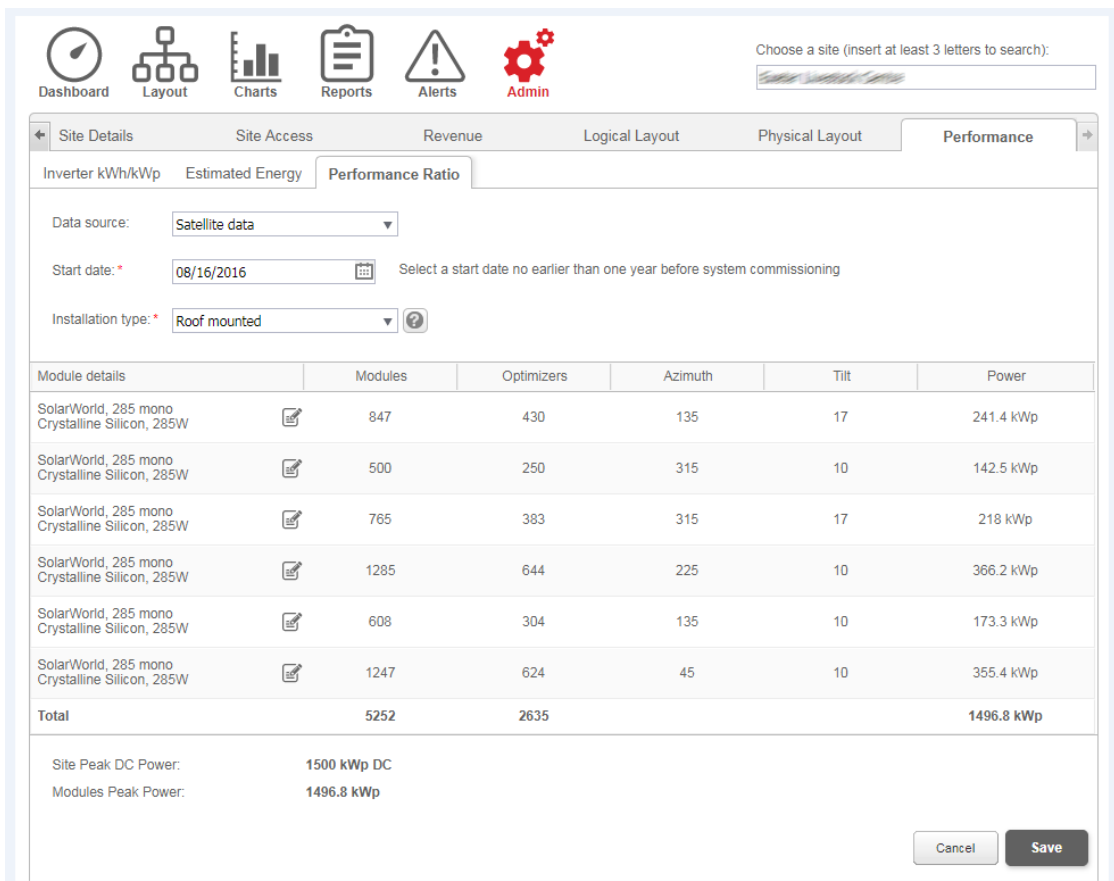


Figure 5: Performance Ratio using Satellite data


8. You can edit the module details by clicking the  icon and inserting the required information in the displayed window:

Figure 6: Module editing window

9. Click **Save** in the Performance Ratio tab. The Performance Ratio chart will be available on the site dashboard within one business day.

Viewing PR

- To view site PR in the site list, add PR columns to the display: Click **Choose Columns** and select one or more of the PR columns: **Last Year PR**, **Last Month PR**, or **Current Year PR**.

Figure 3: Selecting PR columns

- To view the PR in the site dashboard, click the **Dashboard** icon; The Performance Ratio chart is displayed just below the Power and Energy chart. You can toggle between Daily/Monthly/Yearly views and compare the performance results. In the monthly and yearly views, you can also compare to past performance. Both charts (Energy and Performance Ratio) respond to column selection and zoom operations.

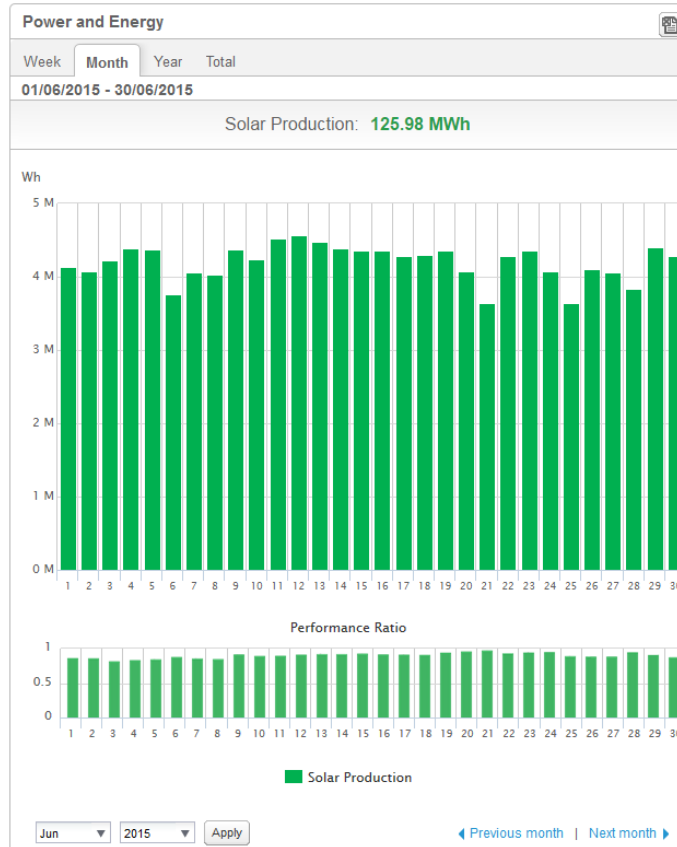


Figure 7: Performance Ratio displayed in the site dashboard

Appendix A: PR Calculation

The ratio between the actual and the expected energy is stated as a percentage and is calculated using the following formulas:

- For a PV system with a single orientation:

$$PR = \frac{\text{Production energy}}{\text{Expected energy}} = \frac{\text{Production energy [Wh]}}{\sum_t \left[\text{Irradiance} \left[\frac{\text{Wh}}{\text{m}^2} \right] \times \frac{\text{Peak power [W]}}{1000 \text{ W/m}^2} \right]}$$

- The production energy is the measurement of the site output in kWh
- The expected energy is calculated by multiplying the sensor readings by the peak power (the nominal site output at STC).

- For a PV system with multiple orientations, you may connect an irradiance sensor (and a CCG) on each facet. In this case, the PR calculation is as follows:

$$PR = \frac{\text{Production energy}}{\text{Expected energy}} = \frac{\text{Production energy [Wh]}}{\sum_t \left\{ \left[\text{Irradiance} \left[\frac{\text{Wh}}{\text{m}^2} \right] \times \frac{\text{Peak power [W]}}{1000 \text{ W/m}^2} \right]_1 + \left[\text{Irradiance} \left[\frac{\text{Wh}}{\text{m}^2} \right] \times \frac{\text{Peak power [W]}}{1000 \text{ W/m}^2} \right]_2 \right\} \dots}$$

- If you use a module temperature sensor to improve the accuracy of the PR calculation, the PR is calculated as follows:

$$PR = \frac{\text{Production energy}}{\text{Expected energy}} = \frac{\text{Production energy}}{\sum_t \left[\text{Irradiance} \left[\frac{\text{Wh}}{\text{m}^2} \right] \times \frac{\text{Peak power [W]}}{1000 \text{ W/m}^2} \right] \times \left[1 + (\text{Temp } [^\circ\text{C}] - 25^\circ\text{C}) \times \text{Temp Coefficient} \left[\frac{\%}{^\circ\text{C}} \right] \right]}$$

- Temp is the module temperature sensor measurement, in °C
- Temp Coefficient is the module’s Pmpp temperature coefficient, taken from the module datasheet, and is always a negative value in %P/°C (or %P/°K)

Appendix B: Software Compatibility Check and Upgrade

To use sensors, the CCG firmware version must be 2.07XX and later.

→ To check the CPU version:

1. Press the Enter button until reaching the following screen:

```
ID : # # # # # # # # # # # #
DSP 1 / 2 : x . x x x x / x . x x x x
CPU : 0 0 0 2 . 0 7 0 0
Country : X X X X X
```

2. SolarEdge devices with earlier firmware versions can be upgraded locally. Contact the SolarEdge support team to obtain the upgrade files and instructions.